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MISSION TRAINING PROGRAM
FOR THE
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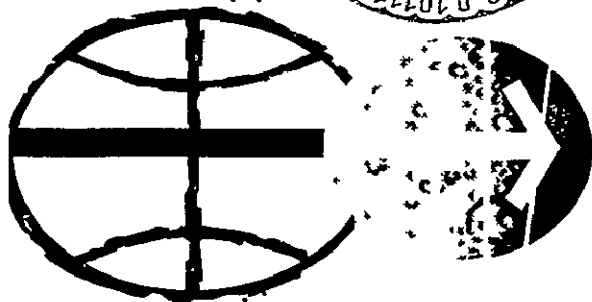
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December 20, 1968

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

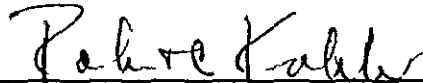
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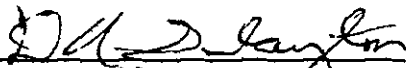


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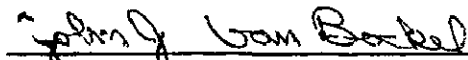
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APOLLO LUNAR LANDING MISSION

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1.0 SUMMARY

Approximately 2300 hours of crew training is programmed to develop a highly skilled crew to fly the Lunar Landing Mission (see table 5.1). In addition to the programmed training, each crewmember will spend many additional hours participating in other training activities, i.e., physical exercise, study, informal briefings and reviews, and necessary mission support activities (A/C flying, suit fits, pilot meetings, travel, physical examination, mission development). Nonprogrammed activities will largely have to be accomplished prior to or after the normal working day. Therefore, optimum utilization of the time available for crew training is a necessity in order to complete the training program outlined in this document.

2.0 INTRODUCTION

This document defines the preflight training and related operational activities of the primary and backup crews designated for the Lunar Landing Mission. It is primarily intended as a guide to the flight crew and personnel responsible for crew training. Modification of the document is the responsibility of the Mission Training Section (MTS), Flight Crew Support Division (FCSD), with the approval of the Director of Flight Crew Operations. The crew commander and training coordinator will tailor the training program to fit the individual crewmember requirements and the objectives of the specific mission as they develop. Training acquired during previous flight assignments will be a major factor used to tailor individual requirements.

Criteria used to develop the training program and overall training objectives are as follows:

- a. The training program encompasses approximately a 12-month period.
- b. Initially, crews will be scheduled for a 2 to 4-day training week to permit incorporation during remaining time of essential mission development activities requiring crew participation early in the training program.
- c. The prime and backup crews will receive the same training. The support crewmembers (a third astronaut crew) will primarily support crew training by substituting for the prime and backup crews in activities that are essential for mission development. Simulator training will be obtained by these crewmembers primarily on a "fill in" basis. In addition, the FCSD flight crew support team will alleviate the crew workload by supporting the crew in their specialty area (procedures, training, stowage, equipment design, flight planning, spacecraft checkout, etc.).
- d. Because of mission complexity and training time constraints, crewmembers will only train for their specific inflight responsibilities with sufficient cross training to assure a redundant capability for the more critical mission tasks.

3.0 TRAINING PROGRAM

3.1 Spacecraft Test Participation

Crew participation in Command and Service Module (CSM) and Lunar Module (LM) spacecraft testing is a major factor in the development of flight systems and operations. The crew will spend approximately 160 cockpit hours and 135 briefing hours during testing at the contractor's facility and at Kennedy Space Center (KSC). Current spacecraft testing nomenclature is Detailed checkout specifications (DCS's) at NR, Downey, operational checkout procedures (OCP's) at GAEC, Bethpage, and, test and checkout procedures (TCP's) at KSC.

The support crew and support team will monitor all major spacecraft tests and brief the crew on the results. The support crew and contractor pilots will significantly reduce prime and backup crew travel by participating in initial spacecraft test run sequences and providing best possible information relative to whether tests will commence as scheduled. Crew participation in spacecraft tests is delineated as follows

Crew Mandatory - One or more members of the prime or backup crew will participate during the test.

Crew Commander's Option - The crew commander has the option to designate an astronaut or contractor pilot to participate in the test.

Crew participation in spacecraft tests will be in accordance with reference 1 and is summarized in table 5.2 and 5 2-A.

3.2 Briefings, Reviews and Meetings

3.2.1 Command Service Module (CSM) Systems Briefings - North American Rockwell (NR) instructors will present a series of systems briefings covering each of the major subsystems, describing each subsystem and emphasizing the operation thereof. Although the crewmembers have previously received Block II systems briefings, they will be covered again in entirety to assure that each crewman has a thorough comprehension prior to initial crew simulator training or participation in spacecraft tests. For maximum retention and learning, briefings will generally be conducted on a 5-hour per day basis. Duration and sequence of the CSM systems briefings is contained in table 5 3. The crew will receive subsequent CSM systems briefings as required with a final crew briefing covering latest modifications and systems anomalies conducted by the NR/KSC Launch Checkout Operations (LCO) test engineers at KSC approximately 2 weeks prior to the mission.

3.2.5.1 Geology Briefings - A series of lectures will be conducted commencing with a review of previously acquired geology training and progressing through specific mission objectives. The content of these briefings will consist of verbal descriptions of geological features, observation techniques, geological sampling, information provided by studies of Ranger, Surveyor, and Lunar Orbiter Data, and photography. Simulated geological missions will be conducted using Apollo tools and instruments. A combination of group and individual lectures are planned in conjunction with several 2-day field trips. The field trips provide a sequence of problem solving exercises under the same constraints anticipated on the lunar surface. A course outline is contained in Table 5.7

3.2.5.2 Biology Briefings - A series of lectures will be conducted to develop a basic understanding of microbiology as it pertains to the lunar surface. The lectures will instruct the crew in techniques and methods for obtaining aseptic samples, and give them an appreciation for the concern of back contamination.

Lecture topics will be grouped under the following general areas:

- (a) Biology, ecology, and exobiology
- (b) The lunar quarantine program
- (c) The role of biosciences in lunar exploration
- (d) Sampling requirements

3.2.5.3 Experiments Briefings - A series of briefings will be conducted to familiarize the crew with the purpose of the various lunar surface experiments, the constraints involved, and the desired results. Whenever feasible, the briefings will be conducted by the principal investigators for the particular experiment. The number of experiments involved will vary with the specific mission. Examples of experiments to be covered are:

- (a) Solar Wind Composition
- (b) Early Apollo Surface Experiment Package (EASEP)
- (c) Apollo Lunar Surface Experiment Package (ALSEP)

3.2.5.4 Equipment Briefings - In conjunction with the experiment briefings, a series of training sessions will be conducted to familiarize the crew with the operation of the experiment hardware. The exercises range from a table top display of the equipment, to a suited exercise of an entire EVA timeline. Some hardware items to be covered are the S-Band Antenna, geological hand tools, sample return containers, cameras, modular equipment stowage assembly (MESA), EASEP and ALSEP.

3.2.6 Photography Briefings - Early in the training program, the crew will receive several briefings by the Mission Operations Branch (FCSD) on the photographic requirements of the mission and operation of the involved photographic equipment. At this time cameras and film will be given to the crew for their practice. Photographic results during training will be critiqued with the crew by the Mission Operations Branch photographic specialists. Photographic training requirements are contained in the Photographic Training Plan Mission G. Reference 7.

3.2.7 Extravehicular Mobility Unit (EMU) Briefing - The crew will receive a briefing and demonstration of the EMU, which consists of the Pressure Garment Assembly (PGA), the Portable Life Support System (PLSS) and the Oxygen Purge System (OPS) by the Crew Systems Division (CSD) or by the contractor personnel (International Latex and Hamilton Standard Corporations, respectively) at the beginning of the training program. Both systems and operational aspects of the EMU will be discussed. Additional knowledge will be gained during subsequent training exercises requiring wearing of this equipment.

3.2.8 Procedures Reviews - Crew participation in procedures reviews is required to assure incorporation of standard operation procedures in all mission planning, documentation, development, hardware testing, and training. The more significant procedures reviews involving crew participation are described below.

3.2.8.1 OCP, DCS and TCP Reviews - The crew will receive briefings on the OCP's, DCS's and TCP's for each of the major spacecraft tests by NR & GAEC test engineers, KSC test engineers, support crew, FCSD support team engineers. The benefits from this are: (a) assurance that the test, from a procedural standpoint, will proceed smoothly and in a safe manner, (b) that the spacecraft checkout procedures correlate as much as possible to actual flight procedures (checklist and Apollo Operations Handbook (AOH), (c) that all pertinent subsystem procedures are exercised and (d) that the crew receives valid procedural practice. The time required for each review depends upon the complexity of the spacecraft test.

3.2.8.2 Checklist and AOH Reviews - In addition to the daily use of the checklist and AOH during training exercises, the crew will participate in continuing reviews of the checklist document starting at F-9 months with a final formal review at F-1 month. The purpose of these reviews is to assure accuracy of the checklist and consistency with related and supporting documentation (AOH Volume II, Rendezvous, Extravehicular Activities (EVA), Abort Summary, Entry Summary and other procedures documents). Additional checklist & AOH reviews will be held as required between crewmembers and the checklist and AOH personnel.

3.2.8.3 Emergency/Abort Procedures Reviews - Emergency and launch abort procedures are covered in the Abort Summary document, AOH Volume II, Lunar Procedures Documents, and the checklist. The crew will participate in formal reviews with FCSD personnel responsible for evaluating and documenting these procedures. Informal reviews of emergency and abort procedures will be scheduled with the crew as required.

3.2.8.4 Rendezvous Procedures Reviews - The crew will receive briefings on rendezvous techniques and procedures from the FCSD Flight Procedures Branch prior to commencement of rendezvous simulation training.

The first briefing will discuss general rendezvous principles, rules and techniques, followed by a brief review of the rendezvous profile. Subsequent briefings will be conducted in conjunction with simulator training to review in detail the profile and procedures for the specific rendezvous planned for the mission, including both nominal and dispersion cases.

3.2.9 Flight Plan Reviews - The crew will participate in flight planning reviews with FCSD flight planning personnel periodically throughout the training program.

3.2.10 Mission Rules Review - The crew will verify feasibility of mission rules in conjunction with integrated simulations (CMS/LMS-MCC). Interim mission rules reviews will be concluded between the Flight Operations Directorate (FOD), crewmembers and FCSD personnel, with a final review at F-6 weeks.

3.2.11 Design and Acceptance Reviews - The crew will participate as available in various spacecraft status reviews (PDR, CDR, CARR), the purpose of which is to verify that the spacecraft is developing according to design and operational criteria, and will satisfy the mission objectives. Because of the crew's experience, their presence is desirable to make judgements concerning spacecraft systems, operations, and checkout procedures. During these reviews, the crew will be appraised of overall spacecraft systems status and any subsequent spacecraft test procedures that they may not already be aware of.

3.2.12 Flight Readiness Review - The crew commanders at their option, will participate in a Flight Readiness Review (FRR) at launch minus approximately 30 days. All major areas are examined at this review including spacecraft, launch vehicle, flight control, crew training, and launch pad and related support.

3.2.13 Training Reviews - Frequent meetings between the crew commander and training coordinator will be convened to implement the overall training program commensurate with the Mission Training Program. The training coordinator will provide the crew current information concerning crew status, requirements, and training equipment capability.

3.2.14 Team Meetings - Meetings will be conducted as required with the FCSD flight crew support team to review the overall mission, spacecraft and action item status.

3.2.15 Pilot Meetings - The flight crews will attend, when possible the pilot's meetings held the first and third Mondays of each month. These meetings provide opportunity for the flight crews to exchange information concerning training activities and flight hardware development.

3.2.16 Lunar Landing Site Briefings - Briefings will be presented to the crew on lunar topography recognition for the three selected landing sites. Training will encompass landing site landmark sighting, powered descent track monitoring, LM pitch variation monitoring, post high gate landing point identification and selection, and post landing location of the LM landing point. Approximately 30 hours will be devoted to the prime site and 20 hours each on the two secondary sites.

3.2.17 Mobile Quarantine Facility (MQF) Briefing - The Mobile Quarantine Facility is designed to biologically isolate the flight crew and support personnel from recovery to delivery to the Lunar Receiving Laboratory at MSC. The crew will be given a functional and operational briefing of approximately four hours on the MQF and its systems with emphasis on communications, oxygen and decompression, sanitation, emergency egress, and crew safety. The briefing will also include a familiarization tour of the Lunar Receiving Laboratory facilities and an explanation of the procedures to be followed during the quarantine period.

3.3 Simulator Training

The crew will receive extensive practice in performing all of the nominal and contingency mission tasks on one or more of the simulators located at MSC, KSC, and the contractor sites. Contractor simulators are primarily intended for engineering development. A brief description of planned crew training on each of the simulators is discussed below, and a summary of simulator training requirements is contained in table 5.1. Although the training, in hours, is broken out for each simulator, the extend of training on each simulator is primarily significant as a nominal training requirement. The total simulation hours do not necessarily reflect completion or noncompletion of the training requirement. Individual crew requirements, in-flight tasks, simulation capability and procedures development are all factors determining the ultimate crew utilization of simulators.

3.3.1 Command Service Module (CSM) Simulators

3.3.1.1 Command Module Simulator (CMS) - The most important as well as extensive CM crew training will be accomplished on the Command Module Simulators, one located at MSC and two at KSC. Utilization of all other simulators is dependent upon availability and operation of these simulators, which are capable of simulating the entire CM mission in the appropriate spacecraft configuration. Options include external visual displays (window, sextant, telescope) and interface with the IMS and the Mission Control Center

Crew training proceeds through three distinct phases, progressing from basic systems familiarization and individual crew tasks (Phase I), through mission simulations (Phase II) and concluding with integrated mission simulations (Phase III).

Typically, each CMS training exercise will include a briefing and debriefing. The briefing will cover salient aspects of the training exercise to be accomplished (mission phase, simulator limitations) and information relating to the system or operations exercised (failure indications, crew procedures and techniques). Crew questions, performance and simulation discrepancies will be reviewed during the debriefing. Regularity and length of the briefings and debriefings will diminish as crew proficiency increases. An outline of the CMS training is contained in table 5.4.

3.3.1.2 Command Module Procedures Simulator (CMPS)- This simulator will be used to familiarize the flight crew in the rendezvous and entry phase of the mission. The nominal concentric rendezvous sequence, passive CSM, will be simulated with the crew monitoring the IM burns beginning with the IM insertion burn. Initial condition reset points will be available before and after the major events. The simulation will include its own programs for CSI, CDH, TPI and plane change maneuvers. CSM active rescue rendezvous capability will also be included. The rescue simulation will include system errors and trajectory dispersions. During the entry phase the CMPS will have the capability to simulate the basic final entry using the Colossus "sixty series" programs and the entry monitor system. The CMPS entry simulation may also have the capability to simulate the programs for the mid-course corrections.

3.3.1.3 Dynamic Crew Procedures Simulator (DCPS) - The crew will utilize the DCPS to obtain basic familiarity and subsequently maintain proficiency in crew procedures relative to the Launch Escape System (LES) and Service Propulsion System (SPS) aborts with the attendant entry maneuver. DCPS training supplements CMS launch abort training due to early availability, quick turnaround, and inclusion of some physical cues (vibration, pitch motion). This training also

provides the crew the opportunity to review with launch vehicle cognizant engineers nominal and abnormal booster systems operations and performance. Training exercises will progress from normal runs with minor deviations to runs with one or more malfunctions inserted. The crew will receive familiarization runs prior to CMS launch abort training, with proficiency runs at specific intervals up to launch date.

3.3.1.4 Rendezvous Docking Simulator (RDS) - The Command Module Pilot will utilize the RDS at Langley Research Center, Virginia for familiarization with CM active (LM rescue) docking procedures. Training will be conducted under both day and night lighting situations.

3.3.2 Lunar Module (LM) Simulators

3.3.2.1 Lunar Module Mission Simulator (LMS) - The most important and extensive LM crew training will be accomplished on the two Lunar Module Mission Simulators, one each, located at MSC and KSC. The extent of crew training on all other LM simulators is dependent upon availability and operation of the LMS(s), which are capable of simulating the entire LM mission in the appropriate configuration with external displays and interfaces with the CMS and the Mission Control Center.

LMS training is phased similarly to that employed in the CMS. Simultaneous with Phase I and Phase II LMS training the crew will accomplish a comprehensive rendezvous training program on the Lunar Module Procedures Simulator (LMPS). Phase I will frequently require only one crewmember in the LMS, whereas Phase II and Phase II will emphasize lunar descent, landing site identification, ascent and rendezvous with the CSM. Phase III will integrate the MSFN controllers and MCC-H into the exercises flown in Phase II. Crew briefings and debriefings will be similar to those conducted in conjunction with CMS training (see paragraph 3.3.1.1). An outline of LMS training is contained in table 5.5.

3.3.2.2 Lunar Module Procedures Simulator (LMPS) - The crew will receive their basic familiarization and initial proficiency training of LM rendezvous procedures and techniques (emphasizing backup G&N modes) related to the Abort Guidance System (AGS) and the Primary Guidance and Navigation Control System (PGNCS) utilizing the LMPS. Prior to intensive LMPS training the crew will have received a comprehensive series of briefings on the LM Guidance and Control system, and will have concluded the G&C subsystems familiarization training utilizing the LMS. Primary emphasis will be placed on ascent from lunar surface and rendezvous with the CSM. Subsequent to the LMPS rendezvous training the crew will develop and maintain proficiency in LM rendezvous utilizing the LMS as part of integrated flight tasks.

3.3.2.3 Translation and Docking Simulator (TDS) - The LM crew will utilize the TDS to become familiar with the LM active docking technique (passive CM). The TDS provides a limited six-degrees-of-freedom simulation of the LM docking maneuver (100 feet to dock) with appropriate control systems (attitude hold, direct, pulse) response. The crew commander will develop proficiency in the LM docking task under various lighting and malfunction (i.e., thruster off) situations.

3.4 Special Purpose Trainers and Facilities

The crew will receive comprehensive operational and procedural experience through simulation exercises in such areas as EVA (lunar surface training, contingency LM-CM transfer), IVA (stowage, CM-LM and LM-CM crew transfer), egress and celestial training. Training for EVA and IVA will be accomplished primarily through the use of full and partial mockups, either as 1 "g" walkthrough exercises or by simulating zero "g" and 1/6 "g" in the Water Immersion Facility (WIF) a KC-135 aircraft flying zero "g" and 1/6 "g" parabolas, and the Partial Gravity Simulator (PGS). The crew will utilize a specially constructed boilerplate command module to practice post landing water egress procedures in the egress tank and at sea; and CM and LM egress mockups to practice altitude chamber and launch pad emergency egress procedures. Supplementary celestial recognition training is achieved through the use of planetariums, at locations conducive to crew utilization. Complete information concerning EVA, IVA, egress and fire training is contained in training documents relating to these areas (references 2 through 6). A brief summary of each type of specialized training is contained in the following paragraphs and tables.

3.4.1 One "g" Walkthroughs - All stowage, EVA and IVA tasks will be practiced in a one "g" condition prior to performing the same in the WIF and thereafter, if required, in the KC-135 aircraft. The crew commander and LM pilot will participate in all CM and LM mockup exercises (stowage, EVA and IVA), whereas the CM pilot will participate only in the CM exercises. A specific amount of training under a one "g" condition is prescribed for each mockup prior to zero "g" crew training exercises.

3.4.1.1 Command Module Mockups - The crew will utilize the CM mockup #28 for stowage practice in conjunction with design reviews at NR (PDR, CCSR, CDR). The crew will utilize the MSC mockups periodically throughout their training program practicing donning/doffing, couch lowering, side hatch operation and egress-ingress.

3.4.1.2 Lunar Module Mockups - The crew will utilize the IM Test Article #1 (LTA-1) for stowage practice and design reviews at GAEC (PDR, CCSR, CDR). The crew will utilize the MSC IM mockups to periodically review IM stowage procedures and EVA tasks, i.e., EMU donning/doffing, forward hatch operation and egress-ingress

3.4.1.3 Transfer Tunnel Mockup - Each crewmember scheduled to transfer from the CM to the IM will practice (4 sessions) the CM to IM and return transfer operations utilizing Mockups 27-A and B. Activities to be practiced are CM hatch operation, IM hatch operation, hard dock latching and unlatching, electrical interface connecting and disconnecting, drogue and probe operations.

3.4.2 Underwater Zero "g" Training - The most important and critical EVA crew training will be accomplished using the MSC Water Immersion Facility (WIF) with pertinent neutral buoyancy mockups oriented to offset the effects of imperfect buoyancy. The crew will practice all major tasks initially utilizing scuba equipment, and subsequently the Pressure Garment Assembly (PGA). The crew will practice the IM and CM EVA transfer and contingency transfer, lunar surface mobility and part task training and the appropriate IVA tasks while in a pressurized suit condition. Prior to crew participation in WIF training exercises the crew will complete the scuba checkout program, an abbreviated underwater PGA checkout program, the specified one "g" walkthroughs for each mockup and one EMU checkout exercise. The overall WIF safety requirements are contained in the FCSD WIF Operational Readiness Plan (ref. 4).

3.4.2.1 Command Module Mockups - Subsequent to completing one "g" exercises the crewmen will perform exercises utilizing the CM neutral buoyancy mockup. During these exercises the crew will practice applicable EVA procedures to include couch lowering, side hatch operation, egress-ingress, and EVA related stowage and housekeeping activities.

3.4.2.2 Lunar Module Mockups - After completing the required one "g" exercises, the IM EVA crewmen will perform several exercises practicing forward hatch operation and egress-ingress tasks.

3.4.2.3 Transfer Tunnel Mockup - Crew transfer training in the WIF will commence only after completing the one "g" walkthroughs and at least one each CM and IM underwater exercise. Crew transfer training will utilize the CM and transfer tunnel mockups to practice CM intra-vehicular transfer preparation, CM to IM intravehicular transfer, and tunnel reconfiguration (three sessions). The second phase of crew transfer training, utilizing the joined CM and IM neutral buoyancy mockups, will consist of practicing tunnel reconfiguration, IM intra-vehicular transfer preparations, one and two crewmen IM to CM intra-vehicular transfer, and one and two crewmen IM to CM extravehicular transfer.

3.4.3 Zero "g" Aircraft Training (Modified KC-135) - Crew training in the KC-135 aircraft will be accomplished either at MSC (EAFB) or at KSC (PAFB) to further define unresolved EVA procedures and supplement the EVA training (particularly such tasks as EMU donning/doffing) previously conducted during one "g" walkthroughs and in the WIF. The zero "g" aircraft training requirements are summarized below.

3.4.3.1 Command Module Mockup - After the crew has completed at least two 1 "g" walkthrough exercises and one CM exercise in the WIF, they will complete two flights of approximately three hours each in the KC-135 aircraft (80 parabolas). Crew training tasks will consist of PGA donning/doffing, couch lowering, side hatch operation and egress/ingress.

3.4.3.2 Lunar Module Mockup - After the crew has completed at least two 1 "g" LM walkthrough exercises and one LM exercise in the WIF, the crew will complete two zero "g" aircraft flights (approx. 80 parabolas) during which they will practice PLSS donning/doffing, forward hatch operation, and egress/ingress tasks.

3.4.3.3 Transfer Tunnel Mockup - Subsequent to completing at least two each 1 "g" and underwater transfer tunnel exercises, the crew will conclude one tunnel exercise in the zero "g" aircraft. During this flight the crew will perform the entire transfer operation one time (30 parabolas), or if more appropriate, concentrate on specific transfer operations not well defined during previous 1 "g" walkthroughs and WIF training.

3.4.4 Partial Gravity Simulator (PGS) - The partial Gravity Simulator, located at MSC, will be utilized in training the crew to accommodate for the limitations and constraints imposed by the combination of the EMU and the lunar 1/6 "g" environment. The PGS is designed to simulate gravitational forces from one "g" to zero "g" for any weight up to 500 pounds. The support system provides three translational degrees of freedom. Fore and aft travel of 50 feet, vertical travel of 19 feet and lateral motion of 2 feet either side of center is possible. Full yaw and pitch and + 30 degrees roll angular freedom is provided. Following one "g" walkthrough exercises, the crew will practice basic mobility, descending and ascending the LM ladder, S-Band antenna deployment, photography, geology equipment retrieval, sample packing, and EASEP/ALSEP extraction, transport and deployment.

3.4.5 Egress Training - Egress training consists of preparing the crew for all preflight and postflight nominal and emergency egress from the spacecraft while in the vacuum chambers, on test stands, on the launch complex and in the water. The crew will practice egress procedures prior to participating in the critical TCP's. Water egress training, which will be accomplished in three phases, and spacecraft prelaunch egress training, are summarized in the following paragraphs (ref. 5)

3.4.5.1 Water Egress Training

Phase I - Procedures familiarization utilizing a CM mockup - The crew will receive a briefing and demonstration of the survival gear components and their operation. Following this, the crew will review egress procedures (unsuited) utilizing the trainer (BP1102A) and survival equipment. During this review, they will receive further instruction on hatch operation, survival equipment stowage, location and removal, and postlanding system activation.

Phase II - Fresh Water Tank Exercise - The crew will receive a briefing on the differences between the spacecraft and the trainer (BP1102A). This briefing will be followed by crew egress (suited) practice from the egress trainer while floating upright (Stable I position) in the flotation tank, located in Building #260 at MSC. Upon completing the Stable I run, the crew will receive a briefing on apex down (Stable II) egress with subsequent practice in uprighting the training article and Stable II egress.

Phase III - Full Scale Recovery Operation in the Gulf of Mexico - The crew will receive a briefing on overall recovery operations and crew recovery procedures. The crew will subsequently practice uprighting the trainer to the Stable I position, egress into their rafts and be picked up by helicopter.

3.4.4.2 Spacecraft Prelaunch Egress Training - The crew will utilize the egress mockups early in the training program to develop familiarity with operation of egress equipment and practice egress procedures in conjunction with closed hatch spacecraft tests in vacuum chambers and on the launch pad. Emergency egress procedures will cover fire (see paragraph 3.4.6), internal, and external contaminants, electrical power failures, and other emergencies.

At approximately F-40 days, the crew will accomplish a launch pad egress exercise at KSC designed to assure a rapid crew egress from the spacecraft and launch pad vicinity. This training will consist of a briefing on the total launch pad operation, followed by a practice launch pad egress walkthrough demonstration of the three evacuation modes: high speed elevator, slide tube, and slide wire. The pad slide wire demonstration will terminate with crew ingress into the cab.

3.4.6 Spacecraft Fire Training - Crew training will consist of review of BP1224 and M6 "burn test" film, a review of flammability deviations, procedural practice simulating cockpit fires in conjunction with one "g" walkthroughs, mockups, simulators, and the spacecraft, and as part of the launch pad emergency and evacuation procedures training at the fire service training area at KSC. The crew will receive a briefing and demonstration of the proper use of the available cockpit fire suppression equipment in the CM and LM by the FCSD egress training project engineer. Further information concerning crew training for fire in and about the spacecraft is contained in the Spacecraft Fire Training document, dated December 12, 1967, (ref. 6).

3.4.7 Planetarium Training - The crew will increase their capability to orient themselves relative to celestial information through periodic utilization of Morehead Planetarium, Chapel Hill, N. C., and the Griffith Planetarium at Los Angeles, California. Particular emphasis will be placed upon learning thoroughly all aspects of the 37 Apollo navigation stars utilized by the Apollo guidance computer. The crew will utilize the Griffith Planetarium during the period that their spacecraft is undergoing tests at NR to study the entire celestial sphere and the specific navigation stars. Subsequent to spacecraft delivery to KSC the crew will utilize the Morehead Planetarium to further study the navigation stars and review those stars and constellations near the orbital track.

3.4.8 Bench Checks - Prior to the accomplishment of spacecraft Crew Compartment Fit and Functional Checks, the Support Team Section (FCSD) will display the equipment to be stowed aboard the spacecraft for review by the crew. Function and operational techniques will be discussed and reviewed at this time.

3.5 Other Training Activities

The crew will be engaged in various other tasks during their pre-flight training program. These are not programmed as part of their formal training for the specific mission because they are either (a) informal training activities accomplished on an individual basis (study, physical training), (b) general training activities for non-specific mission (aircraft flying), or (c) crew activities in support of the mission or Apollo program (suit fits, physical examinations, pilot meetings, travel, flight monitoring, engineering and operational development effort). Except for the Lunar Landing Training Vehicle (LLTV) checkout program and centrifuge training, these activities, and the hours involved are not contained in this document. However, they are important considerations in scheduling crew training activities.

3.5.1 Lunar Landing Training Vehicle (LLTV) Checkout and Currency Flight - The LLTV checkout and proficiency requirements as presently established are as follows:

Pre-Checkout Requirements

- a. Helicopter checkout - Minimum of 100 hours and 5 hours in the 30 days preceding first LLTV flight.
- b. Approximately ten flights utilizing the Langley Lunar Research Facility (LLRF) at Langley Research Center. The LLRF is a tethered simulation of the lunar landing phase (175' vertical).
- c. A progressive series of pre-LLTV flights on the LLTV simulator (10 hours).
- d. Ejection seat swing at Weber Aircraft Co., Burbank, California, (1 day).

Checkout

- a. Ground school, ground run, and c. g. fixture attitude rocket firings.
- b. Approximately thirteen progressive flights (initial transition syllabus) under supervision of a staff instructor pilot.
- c. Series of twelve proficiency flights (2 flights/week).

Currency

- a. Minimum of two full lunar LLTV flight simulations per 30-day period (preferably bi-weekly).

3.5.2 Centrifuge - The crew will utilize the MSC Flight Acceleration Facility (centrifuge) to obtain experience in flying "closed loop" lunar return entries within the nominal reentry corridor utilizing the Entry Monitor System (EMS) and the SCS control system. The Command Module Pilots will fly several static and dynamic entry runs in a shirtsleeve condition. Thereafter, the entire prime and backup crews will don their PGA's and fly several entries with the final run concluded with the suits pressurized. (See table 5.8 for run summary).

4.0 REFERENCES

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3. Garrett, D., Water Immersion Facility Activities in Support of Apollo Mission, memorandum CF221-7M-184 dated June 12, 1967.
4. Zaleski, J. R., Water Immersion Facility Operational Readiness Plan, Crew Station Branch, FCSD document dated May, 1968.
5. Ward, T., Crew Egress Training Plan for Apollo Block II Missions, Revision "A", Mission Training Section, FCSD document dated February 20, 1968.
6. Ward, T., Spacecraft Fire Training Plan, Mission Training Section, FCSD document dated December 12, 1967.
7. Teague, W., Photographic Training Plan Mission G, Mission Operations Branch, FCSD document dated February 14, 1969.

TABLE 5.1 - CREW TRAINING SUMMARY

NOTE - Only the formal crew training activities are listed. Total crew involvement exceeds these hours with considerable variance between crewmembers due to crew position and preflight assignments.

ACTIVITY	HOURS	ACTIVITY	HOURS
Briefings & Reviews		Simulators (LM)	
CSM	140	LMS	200
LM	100	LMPS	60
L/V	20	FMES (GAEC)	10
G&N Programs	75	LM Hybrid (MIT)	10
EMU	4	TDS	12
Photography	8	Simulator Brief	60
Lunar Surface	141		
Procedures		Special Purpose Training	
C/L & AOH	50	Stowage	30
OCP, TCP & DCS Review	75	Walkthroughs	97
Design & Acceptance	60	WIF C/O (scuba, PGA)	50
Reviews			
Rendezvous	30	Water Immersion Facility	36
EVA	15	Zero "g" Aircraft	15
Emer., Abort, Rules	40	Partial Gravity Simulator	15
Flight Plan	50	EMU C/O	12
Training	30	Egress	20
Team	60	Spacecraft Fire Training	10
Flt. Readiness	10	Bench Checks	8
Lunar Landing Site	70	Planetarium	30
Mobile Quarantine Facility	4	LLTV C/O Program	86
		Centrifuge	4
S/C TCP's (cockpit)			2260
CSM	80		
LM	80		
Simulators (CM)			
CMS	200		
CMPS	60		
Mission Eval. (N/R)	10		
Cm Hybrid (MIT)	10		
DCPS	15		
RDS	8		
Simulator Brief	60		

TABLE 5.2 - CREW PARTICIPATION IN CSM DCS's AND TCP's

	DOWNEY	KSC
Mandatory		CM-LM/AS Mech Docking Emerg. Egress and Simulated Altitude Chamber Tests (CCFF conducted by TPS) Altitude Chamber Tests Pad Emergency Egress Test FRT Crew C/D CDDT/COUNTDOWN
Optional	Comm System C/O G&N System Functional Verif. RCS Elect. System Verif. SECS C/O SPS Electrical & Instr. Verif. SCS Subsystem Test S-Band Antenna Verif. Control System Interface C/O Integrated Test Crew Equip. Stowage Crew Equip. Integration Crew Equip. Bench Check	Combined Systems Test HGA C/O & PLES Comm Test Integrated Systems Test Elect. Interface Test Plugs In Integrated Test CSM/LM MCC-H Test

TABLE 5.2A - CREW PARTICIPATION IN LM OCP'S AND TCP'S

	BETHPAGE	KSC
Mandatory		CM/LM Mech. Docking SIM ALT RUN and Egress Demonstration (CCFF conducted by TPS) Altitude Chamber Run FRT CSM/LM MCC-H Test CDDT/Launch Countdown
Optional	Data Ch. Verification Combined Sub-Systems FEAT/EMC Systems (Plugs In) FEAT/EMC Mission (Plugs Out) CCFF Descent Stage Equip. -Fit & Function	EASEP/ALSEP/MESA Fit & Functional Comb. Sub-Systems Test Fluids Testing

TABLE 5.3 - COMMAND MODULE SYSTEMS BRIEFINGS HOURS (CONTRACTOR)

SUB-SYSTEM	INITIAL (MSC)	INTERIM	FINAL (KSC)
EPS	6	3	1
COMM	6	3	1
Docking	4	2	
SECS	12	4	2
Prop & RCS	12	4	2
ECS	12	3	2
G&C	40	16	3

TABLE 5.3A - LUNAR MODULE SYSTEMS BRIEFINGS HOURS (CONTRACTOR)

SUB-SYSTEM	INITIAL (MSC)	INTERIM	FINAL (KSC)
EPS	4	2	1
COMM	6	2	1
Instrumentation	4	2	1
Prop & RCS	8	3	1
ECS	8	2	1
CES	6	2	1
Radar	6	2	1
AGS	6	4	1
PGNS	15	8	2

TABLE 5.4 - CMS CREW TRAINING SUMMARY

Requirements of the exercises delineated below cannot, in most cases, be accomplished in one session. The pacing constraints are the briefing and simulator session times, typically one hour and three hours respectively. Other factors are the learning rate (proficiency level) of the individual crewman, and the responsibility areas imposed by crew position. In light of this, no attempt is made to assign hours to specific exercises. Instead, a total requirement of 200 hours of simulator time (minimum) and 60 hours of briefing time has been established.

PHASE I - SYSTEM FAMILIARIZATION

EXERCISE 1 - Electrical Power System

BRIEFINGS

A. EPS Requirements

1. D-C Pwr generation and distribution
2. A-C Pwr generation and distribution

B. Mission Phase Requirements

1. Prelaunch
2. Ascent
3. Orbital (translunar, transearth)
4. Entry

C. Crew Procedures - Operation & Management

1. Cryogenics parameters check
2. Fuel cell purge - H₂ and O₂
3. Peak power - preparation for and return to nominal
4. Battery charge - status check, initiation and termination
5. EPS periodic checks

D. Malfunction Analysis

1. DC
 - a. Power generation
 - b. Power distribution
2. AC
 - a. Power generation
 - b. Power distribution

3. Cryogenic gas storage subsystem

SIMULATOR EXERCISES

A. Prelaunch Status Checks

1. FC Rad
2. FC Htrs
3. FC Purge
4. FC Reac
5. FC Main Bus A
6. FC Main Bus B
7. FC Ind
8. Batt Charge
9. DC Ind
10. AC Inv

B. Inverter Operation

1. Standby Inverter
2. Dual Inverter

C. Periodic Verification & Tests

1. Cryogenic Pressure - Quantity
2. FC Power Plant
3. DC Voltage - Amperage
4. AC Voltage
5. Battery Charging
6. FC Power Plant Purging
7. H2 or O2 Quantity Balance Correction

D. Fuel Cell Switching

E. Inverter Changeover

F. Malfunctions

See Section 5 - Contingency Procedures of the Applicable
Vol. 2 of the AOH

EXERCISE 2 - Environmental Control System

BRIEFINGS

A. ECS Requirements

1. Oxygen supply subsystem
2. Pressure suit subsystem
3. Water subsystem
4. Entry

B. Crew Procedures - Operation and Management

1. Prelaunch
2. Orbital, Translunar, Transearth
3. Entry
4. Waste Management

C. Malfunction Analysis

1. Oxygen supply
2. Pressure Suit
3. Water
4. Water glycol
5. Temperature Control

SIMULATOR EXERCISES

A. Prelaunch

1. ECS valve status
2. Cryogenic status
3. Secondary glycol loop check
4. Primary glycol loop activation
5. Suit circuit flow
6. Suit hookups
7. Pressure suit circuit and PGA check

B. Periodic Verification & Tests

1. ECS monitoring check
2. ECS redundant component check
3. CO2 absorber filter replacement
4. Debris screen check
5. Potable water chlorination
6. PGA/shirtsleeve mode changes
7. Waste Management procedures
8. CM repressurization
9. PGA verification check
10. Hygrometer operations
11. CM O2 supply refill
12. CM pressure dump
13. Suit circuit purge of H2
14. Cabin cold-soak operation

C. Deorbit

D. Earth landing

E. Post landing

F. Malfunctions

EXERCISE 3 - Telecommunication

BRIEFINGS

A. Mission Requirements

1. Voice
2. Video
3. Updata
4. Tracking
5. Recovery

B. Equipment Functions & Operation

1. Audio Center
2. VHF/AM Transmitter - Receiver
3. Multiplexer
4. Antennas
5. Signal Conditioners
6. PCM Telemetry
7. Premodulation Processor
8. Data Storage Equipment
9. VHF/FM Transmitter
10. Unified S-Band
11. S-Band Power Amplifier
12. C-Band Transponder
13. Up-Data
14. TV Camera
15. VHF Beacon
16. Central Timing

C. Telecommunications Operation Procedures

1. Prelaunch
2. Earth Orbit, Translunar, Lunar Orbit, Transearth
3. High Power
4. Low Power
5. Recovery

D. Malfunctions - Alternate Mode/Backup Switching

SIMULATOR EXERCISES

A. Pad Communications

B. Basic Switching

1. Audio Panel
2. S-Band Normal
3. S-Band Aux
4. Up Telemetry
5. S-Band Antenna
6. VHF AM

7. VHF Beacon
8. Tape Recorder
9. Power
10. TLM Inputs
11. VHF Antenna
12. Panel 2 Switches
13. ~~RNDZ~~ XPNDR

- C High-Gain Antenna Operation
- D. S-Band Xponder Modes
- E. FM Transmitter Modes
- F. VHF/AM Modes
- G. DSE Record Modes
- H. Flight Qual RCDR Record Mode
- I. Conference Mode
- J. Rendezvous Transponder Activation & Self Test
- K. Back-up Modes
- L. Malfunctions

See Section 5 - Contingency Procedures of the Applicable
Vol. 2 of the AOH

EXERCISE 4 - Service Propulsion System & Reaction Control Systems

BRIEFINGS

- A. Propulsion System
1. SPS
 2. SM-RCS
 3. CM-RCS
- B. SPS
1. Controls & displays
 2. Status check
 3. Monitoring & gaging
 4. Firing

C. RCS

1. SM-RCS Status check
2. CM-RCS status check

D. Malfunctions

1. SPS

- a. Pressure
- b. Propellant
- c. Engine
- d. TVC

2. RCS

a. SM-RCS

- (1) pressure
- (2) propellant
- (3) engine

b. CM-RCS

- (1) pressure
- (2) propellant
- (3) engine

SIMULATOR EXERCISES

A. Prelaunch

1. SPS

a. Indicators

- (1) pressure
- (2) temperature
- (3) gauges

b. Switches

c. Gimbal drives

2. RCS

a. SM

- (1) propellant
- (2) temperature
- (3) pressure
- (4) quantity
- (5) valves

b. CM

- (1) propellant
- (2) temperature
- (3) pressure
- (4) quantity
- (5) valves

c. SM-RCS ground firing test

B. Orbital Monitoring Checks (Systems Management)

1. SPS

a. Indicators

- (1) pressure
- (2) temperature
- (3) gauges

b. Quantity

c. Valves

2. RCS

a. SM

- (1) pressure
- (2) temperature
- (3) quantity
- (4) propellant

b. CM

- (1) pressure
- (2) temperature
- (3) quantity
- (4) propellant

C. Malfunctions

See Section 5 - Contingency Procedures of the Applicable
Vol. 2 of the AOH

EXERCISE 5 - Guidance & Navigation and Stabilization & Control
System Attitude Control

BRIEFINGS

A. Review of Subsystems Functions Associated with Attitude Control

1. G&N Subsystem
 - a. Rotational Control
 - b. Translation Control
 - c. Attitude Stabilization
 - d. Crew Displays
 2. SCS
 - a. Rotational Control
 - b. Translation Control
 - c. Attitude Stabilization
 - d. Crew Displays
- B. G&N Attitude Control Mode
1. Subsystem Requirements
 - a. G&N
 - b. SCS
 - c. RCS
 2. Crew Procedures
 - a. Subsystems Setup
 - b. Rotational Maneuver (SM-RCS)
 - c. Rotational Maneuver (CM-RCS)
 - d. Translation Maneuver
 - e. G&N Attitude Hold
 - f. G&N Local Vertical
- C. SCS Attitude Control Mode
1. Subsystem Requirements
 - a. SCS
 - b. G&N
 - c. RCS
 2. Crew Procedures
 - a. Subsystems Setup
 - b. Rotational Maneuver (SM-RCS)
 - c. Rotational Maneuver (CM-RCS)
 - d. Translational Maneuver
 - e. Manual Direct
 - (1) Attitude Maneuver (SM-RCS)
 - (2) Attitude Maneuver (CM-RCS)
 - f. SCS Attitude Hold

- D. SCS Local Vertical Mode
 - 1. Subsystems Requirements
 - 2. Crew Procedures
 - a. Minimum
 - b. Maximum
- E. Attitude Control Applications
 - 1. Navigation Sightings
 - 2. SPS Firings
 - 3. Attitude Hold
 - 4. Local Vertical
 - 5. Thermal Control
- F. Malfunction Analysis
 - 1. G&N
 - 2. SCS
 - 3. RCS

SIMULATOR EXERCISES

- A. G&N and SCS Set-Up, Power On Verification
- B. SM-RCS Attitude & Translation Control
 - 1. G&N Mode
 - 2. SCS Mode
 - 3. Manual Direct Modes
- C. CM-RCS Attitude Control
- D. S-IVB RCS Attitude Control
- E. Malfunctions

See Section 5 - Contingency Procedures of the Applicable
Vol. 2 of the AOH

EXERCISE 6 - G&N Navigation & IMU Alignment

BRIEFINGS

- A. Introduction
 - 1. G&N Requirements
 - 2. Inertial Guidance
 - 3. Optical Navigation
 - 4. Spacecraft Interface

B. Subsystems

1. Inertial

- a. Components & functions
- b. Modes of operation

2. Optical

- a. Telescope
- b. Sextant
- c. Loops
- d. Modes of operation

3. Computer

- a. Instructions
- b. Priority
- c. Programs
- d. Input/Output interfaces

C. Controls & Displays - LEB

1. Inertial

2. Optical

3. Computer

4. Map & Data Viewer

D. Crew Procedures

1. Attitude Control

- a. Attitude Maneuvering Control
- b. Attitude Hold

2. Navigation Sightings

- a. Normal
- b. Manual

3. IMU Alignment

- a. Normal Computer Controlled
- b. Manual Back-up

E. Malfunctions

1. Inertial

2. Optical

3. Computer

SIMULATOR EXERCISES

A. IMU alignment

1. G&N Activation
2. IMU Alignment
3. GCD Alignment
4. CSM Alone
5. S-IVB Attached
6. LM Attached
7. IMU Realignment
8. Manual IMU Alignment

B. Earth Orbit Navigation

1. Run through ground track determination program and earth landmark tracking navigation procedures.
2. Practice G&N activation, IMU alignments, and orbit measurement by earth landmark tracking.
3. Practice lunar landmark navigation.

C. Star-Landmark or Horizon Navigation

1. Run through star-lunar landmark and horizon navigation procedures
2. Practice star-earth landmark and horizon navigation procedures with/without LM attached.

D. Malfunctions

See Section 5 - Contingency Procedures of the Applicable
Vol. 2 of the AOH

EXERCISE 7 - Delta V Operations

BRIEFINGS

A. Review of Subsystem Functions

1. G&N
2. SCS
3. RCS
4. SPS

B. Functional Interface Required for Delta-V Maneuvers

C. Crew Procedures

1. G&N Mode

- a. Navigation sightings for determination of trajectory parameters
- b. IMU alignment
- c. SCS preparation
- d. G&N preparation
- e. SPS preparation
- f. SM-RCS ullage & SPS firing
- g. Delta-V verification

2. SCS Mode

- a. Trajectory determination
- b. IMU Alignment
- c. SCS preparation
- d. SPS preparation
- e. SM-RCS ullage & SPS firing
- f. Delta-V verification

D. Applications

1. Altitude change
2. Plane change
3. Retro Maneuver

E. Malfunctions

1. G&N
2. SCS
3. RCS
4. SPS

SIMULATOR EXERCISES

A. Run-Through Procedures for Delta-V in Following Modes

1. G&N
2. SCS Automatic
3. SCS Rate Command
4. SCS Acceleration Command
5. G&N/S-IVB
6. TVC

B. Practice G&N Mode

C. Practice G&N Mode with Restart

D. Practice SCS Automatic Mode

- E. Practice SCS Rate Command TVC Mode
- F. Practice SCS Acceleration Command TVC Mode
- G. Practice G&N Controlled S-IVB Mode
- H. Malfunctions

See Section 5 - Contingency Procedures of the Applicable
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EXERCISE 8 - CM-SM Separation & Entries

BRIEFINGS

- A. Review of subsystem functions
 - 1. G&N
 - 2. SCS
 - 3. RCS
 - 4. ECS
 - 5. EPS
 - 6. EMS
 - 7. SECS
 - 8. EDS
- B. G&N Mode CM-SM Separation
 - 1. Entry parameters
 - 2. SM Separation parameters
 - 3. Attitude maneuvering to desired plane & SCS alignment
 - 4. Attitude maneuvering to desired plane for CM-SM separation
 - 5. ECS preseparation check
 - 6. EPS preseparation check
 - 7. EMS preseparation check
 - 8. Initiate & Monitor Separation
- C. SCS Mode CM-SM Separation (Functions Differing From G&N)
 - 1. Confirm entry parameters with MSFN
 - 2. SCS Attitude maneuvering
- D. G&N Mode Entry Preparation
 - 1. Post-separation check
 - a. Mission sequencer
 - b. CM-RCS
 - c. EPS
 - d. ECS
 - 2. Preentry checks

- a. CM-RCS
- b. G&N & SCS
- c. CM Attitude orientation

E. SCS Model Entry Preparation (Functions Differing from G&N)

- 1. SCS entry check
- 2. CM attitude orientation

F. G&N - Controlled Entry

- 1. Monitor operational status of controls & displays
- 2. Monitor entry attitude & roll control hold on FDAI
- 3. Monitor programmed range control maneuver
- 4. Monitor programmed glide maneuvers

G. SCS - Controlled Entry

- 1. Rate command
- 2. Manual direct control

H Malfunctions

- 1. G&N
- 2. SCS Rate command
- 3. Manual direct
- 4. CM-RCS
- 5. ELS
- 6. EDS

SIMULATOR EXERCISES

A. G&N Mode Entry

- 1. CM-SM Separation
- 2. Entry and monitor-control of earth landing sequence

B. Entry Contingencies

- 1. CM-SM separation and SCS rate command entry
- 2. CM-SM separation and SCS acceleration command entry
- 3. CM-SM separation and manual direct entry
- 4. SCS rate command entry with selected axis jet inoperative
- 5. Manual direct entry with selected axis jet inoperative
- 6. Retrograde, separation, SCS mode entry, and monitor control of ELS with sequence malfunctions
- 7. Entry using SCS rate command and acceleration command and the EMS.

C. Malfunctions

See Section 5 - Contingency Procedures of the Applicable
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PHASE II - MISSION SIMULATIONS

EXERCISE 9 - CM Thrusting Maneuvers

A. SPS

1. Delta V's
 - a. CSM
 - b. CSM & LM
2. Midcourse corrections
 - a. Translunar
 - b. Transearth
3. Entry into lunar orbit
4. Transearth injection
5. LM Rescue
6. Return to earth orbit

B. S-IVB

C. LM-DPS & APS

D. For Contingency Operations, practice with backup modes and procedures

EXERCISE 10 - CM Rendezvous & Docking

A. 3-Man Operation

1. Separation from S-IVB
2. Transposition
3. Docking with LM attached to S-IVB
4. LM extraction

B. 1-Man Operation

1. CSM-LM Rescue
 - a. Higher concentric
 - b. Low concentric

- C. For Contingency Operations, practice with backup modes and procedures

EXERCISE 11 - CM Deorbit & Entry

- A. Lunar Return Reentry
1. Separation
 2. Modes
 - a. G&N
 - b. 'SCS-rate' command
 3. Earth landing sequence
- B. Earth orbit reentry
1. Separation
 2. Modes
 - a. G&N
 - b. SCS rate command
 3. RCS deorbit
- C. For contingency operations, practice back-up modes and procedures

EXERCISE 12 - CM Mission Segment I

- A. Launch
- B. Insertion
- C. S-IVB in earth parking orbit

EXERCISE 13 - Mission Segment II

- A. TLI, pre and post TLI
- B. IMU alignment
- C. Navigation
- D. Low power systems operation

EXERCISE 14 - CM, Mission Segment III

- A. Prepared for midcourse maneuver
- B. Perform G&N Delta V

EXERCISE 15 - CM Mission Segment IV

- A. Final TL midcourse maneuver

- B. Pre LOI LM checkout
- C. LOI Delta V
- D. Lunar orbit navigation

EXERCISE 16 - CM Mission Segment V

- A. LM Checkout support
- B. Optically track LM in descent
- C. Support LM pre ascent checkout
- D. Optically track LM in ascent
- E. Post docking activities
- F. LM jettison

EXERCISE 17 - CM Mission Segment VI

- A. TEI Delta V
- B. Navigation
- C. TE midcourse correction
- D. CM-SM separation & entry

EXERCISE 18 - CM Mission Segment VII

- A. CSM rescue rendezvous from lower concentric orbit
- B. CSM rescue rendezvous from higher concentric orbit

EXERCISE 19-25 - Rerun of Mission Segment I Through VII

Wearing PGA's

With Random Malfunctions Inserted

(REF: Section 5

Contingency Procedures of the Applicable Vol. 2 of the AOH)

EXERCISE 26 - CM Aborts

- A. Mode IA, IB, IC
- B. Mode II, III, IV
- C. TLI and LOI Aborts

PHASE III - INTEGRATED SIMULATIONS

Integrated simulations provide the most sophisticated training for the crews and are in fact dress rehearsals of mission segments employing the coordination of FCOD (crews, simulators, flight plan) and FOD (MCCH, Flight Controllers, Mission Rules). Full crew complement

is employed in the execution of these simulations.

EXERCISE 27 - Launch Simulations (3 exercises)
EXERCISE 28 - CSM (Orbital Activity) Simulations (4 exercises)
EXERCISE 29 - LM (Lunar Ascent & Descent) Simulations (4 exercises)
EXERCISE 30 - CSM-LM Simulations (4 exercises)
EXERCISE 31 - Reentry Simulations (2 exercises)

TABLE 5.5 - LMS CREW TRAINING SUMMARY

Criteria and hours established for the Lunar Module Simulator are identical to that of the CMS (REF: Table 5.4).

PHASE I - SYSTEM FAMILIARIZATION

EXERCISE 1 - Electrical Power System

BRIEFINGS

- A. Activation (checkout)
 - 1. Battery
 - 2. Battery management
 - a. Ascent
 - b. Descent
 - 3. Lighting
 - 4. Lighting Control
- B. Malfunction Analysis

SIMULATOR EXERCISES

- A. Activation (checkout)
 - 1. Battery
 - 2. Battery management
 - a. Ascent
 - b. Descent
 - 3. Lighting
 - 4. Lighting Control
- B. Malfunctions

See Section 5 - Contingency Procedures of the Applicable
Vol. 2 of the AOH

EXERCISE 2 - Communications

BRIEFINGS

- A. Transmission & Activation (checkout)

1. VHF
2. S-Band
3. Television camera
4. Telemetry

B. Set up Major modes of VHF & S-Band transmission

C. Malfunction Analysis

SIMULATOR EXERCISES

A. Transmission & Activation (checkout)

1. VHF
2. S-Band
3. Television camera
4. Telemetry

B. Set up major modes of VHF & S-Band transmission

C. Malfunctions

See Section 5 - Contingency Procedures of the Applicable
Vol. 2 of the AOH

EXERCISE 3 - Environmental Control System

BRIEFINGS

A. Activation (checkout)

1. Cabin Fan
2. Suit
3. Water Management
4. Oxygen
5. Cabin pressure
6. Waste Management
7. ARS Pressurization
8. Heat transport section (backup)

B. Heat transport section checkout

C. LiOH cannister replacement

D. Suit checkout

E. Cabin & ARS pressurization

F. Malfunction Analysis

SIMULATOR EXERCISES

- A. Activation (checkout)
 - 1. Cabin fan
 - 2. Suit
 - 3. Water Management
 - 4. Oxygen
 - 5. Cabin Pressure
 - 6. Waste Management
 - 7. ARS Pressurization
 - 8. Heat Transport Section (backup)
- B. Heat transport section checkout
- C. LiOH cannister replacement
- D. Suit checkout
- E. Cabin & ARS Pressurization
- F. Malfunctions

See Section 5 - Contingency Procedures of the Applicable
Vol. 2 of the AOH

EXERCISE 4 - RCS System

BRIEFINGS

- A. Activation (System A&B)
 - 1. Checkout
 - 2. Pressurization
 - 3. Temperature & Pressure checks
 - 4. Fuel & Oxidizer
 - 5. Caution & warning indicators
- B. Hot and Cold Firing
 - 1. Pressure
 - 2. Quantity
- C. Malfunctions Analysis

SIMULATOR EXERCISES

- A. Activation (systems A&B)
 - 1. Checkout

2. Pressurization
 3. Temperature & pressure checks
 4. Fuel & oxidizer
 5. Caution & warning indicators
- B. Hot and cold firing
1. Pressure
 2. Quantity
- C. Malfunctions

See Section 5 - Contingency Procedures of the Applicable
Vol. 2 of the AOH

EXERCISE 5 - Descent Propulsion System

BRIEFINGS

- A. Activation (checkout)
1. Pressure
 2. Helium
 3. Fuel
 - a. Temperature
 - b. Pressure
 4. Oxidizer
 - a. Temperature
 - b. Pressure
- B. Performance
1. Arming
 2. Ignition
 - a. Automatic
 - b. Manual
 3. Descent Firings
- C. Postlanding
1. Shutdown
 2. Venting
- D. Malfunction Analysis

SIMULATOR EXERCISES

A. Activation (checkout)

1. Pressure
2. Helium
3. Fuel
 - a. Temperature
 - b. Pressure
4. Oxidizer
 - a. Temperature
 - b. Pressure

B. Performance

1. Arming
2. Ignition
 - a. Automatic
 - b. Manual
3. Descent firings

C. Postlanding

1. Shutdown
2. Venting

D. Malfunctions

See Section 5 - Contingency Procedures of the Applicable
Vol.2 of the AOH. _____

EXERCISE 6 - Ascent Propulsion System

BRIEFINGS

A. Status monitoring (checkout)

1. Pressurization
2. Helium
3. Fuel
4. Oxidizer
5. Indicators

B. Ignition

1. Automatic
2. Manual

C. Malfunction Analysis

SIMULATOR EXERCISES

A. Status monitoring (checkout)

1. Pressurization
2. Helium
3. Fuel
4. Oxidizer
5. Indicators

B. Ignition

1. Automatic
2. Manual

C. Malfunctions

See Section 5 - Contingency Procedures of the Applicable
Vol. 2 of the AOH

EXERCISE 7 - Stabilization and Control System

BRIEFINGS

A. Flight control display during MPS thrusting

B. Manual attitude control

1. Descent stage attached engine not firing
2. Descent stage attached to engine firing
3. Rate of descent (Low gate to touchdown)

C. Manual ullage

D. Manual attitude control

1. Ascent engine firing
2. Ascent engine not firing

E. Manual flight control maneuvers

1. Pulse
2. Direct

F. Malfunction Analysis

SIMULATOR EXERCISES

A. Flight control display during MPS thrusting

- B. Manual attitude control
 - 1. Descent stage attached engine not firing
 - 2. Descent stage attached engine firing
 - 3. Rate of descent (low gate to touchdown)
- C. Manual ullage
- D. Manual attitude control
 - 1. Ascent engine firing
 - 2. Ascent engine not firing
- E. Manual flight control maneuvers
 - 1. Pulse
 - 2. Direct
- F. Malfunctions

See Section 5 - Contingency Procedures of the Applicable
Vol. 2 of the AOH

EXERCISE 8 - Abort Guidance System

BRIEFINGS

- A. LGS Initialization
- B. IMU Startup, deactivation & realignment
- C. AGC startup, checkout and initialization
- D. LGC update and LR checkout
- E. AGS alignment, calibration & update
- F. DEDA operations
- G. AGS operation & deactivation
- H. Malfunction Analysis

SIMULATOR EXERCISES

- A. LGS initialization
- B. IMU startup, deactivation & realignment
- C. AGC startup, checkout and initialization
- D. LGC update & LR checkout
- E. AGS alignment, calibration & update
- F. DEDA operations
- G. AGS operation & deactivation
- H. Malfunction

See Section 5 - Contingency Procedures of the Applicable
Vol. 2 of the AOH

EXERCISE 9 - Primary Guidance System

BRIEFINGS

- A. LGS Initialization
- B. IMU startup, deactivation & realignment
- C. AGC startup, checkout and initialization
- D. LGC update & LR checkout
- E. DSKY & DEDA operations
- F. RR checkout & lock-on
- G. PGNS rendezvous operations
- H. Malfunction Analysis

SIMULATOR EXERCISES

- A. LGS initialization
- B. IMU startup, deactivation, & realignment
- C. AGC startup, checkout & initialization
- D. LGC update & LR checkout
- E. DSKY & DEDA operations
- F. RR checkout & lock-on
- G. PGNS rendezvous operations
- H. Malfunction Analysis

See Section 5 - Contingency Procedures of the Applicable
Vol 2 of the AOH

CAUTION & WARNING SYSTEM

The caution and warning system will not be covered as a separate subsystem. The CWS applicable to the other S/C systems will be covered with those systems.

EXPLOSIVE DEVICES SYSTEM

The explosive devices system will not be covered as a separate subsystem. The explosive devices applicable to the other S/C systems will be covered with those systems.

PHASE II - MISSION SIMULATIONS

EXERCISE 10 - LM Guidance and Control

- A. IMU Alignment
 - 1. Activation & checkout
 - 2. Coarse alignment attached to CSM - separate & realign
 - 3. Orientation determination in coasting flight

4. Realign in coasting descent
 5. Orient & realign on lunar surface
 6. Backup procedures on lunar surface
- B. G&N Operations
1. Rendezvous & landing radar activation & checkout
 2. RR CSM auto track mode
 3. RR manual acquisition and track
 4. G&N DPS Delta V
- C. Manual Flight Control
1. Attitude Control
 - a. Descent engine firing
 - b. ROD thrust control
 - c. Ascent engine firing
 - d. Translation control after ascent engine burnout
 2. Auto attitude control
 - a. Manual DPS throttle control
- D. For Contingency Operations, practice with backup modes and procedures

EXERCISE 11 - LM Rendezvous & Docking

- A. Rendezvous
1. Auto & manual separation
 2. CSI, CDH, TPI, TPM
 - a. Delta V's in G&N mode
 - b. Delta V's in AGS
 3. Terminal rendezvous maneuvers
 - a. G&N Monitor
 - b. AGS Monitor
- B. Docking
1. Practice using PGNS control modes
 2. Practice using AGS control modes
- C. For Contingency Operations, practice with backup modes and procedures

EXERCISE 12 - LM Powered Descent & Landing

- A. Landing
 - 1. Automatic
 - 2. Manual
 - a. Hover point
 - b. Low gate
- B. PGNS descent with landing point redesignated at H₁-gate (docked)
- C. PGNS descent with landing point redesignated at hi-gate - manual take over at lo-gate
- D. For Contingency Operations, practice with backup modes and procedures

EXERCISE 13 - LM Prelaunch & Ascent

- A. Prelaunch
 - 1. Preparation
- B. Ascent
 - 1. Manual takeover to obtain safe orbit
 - 2. Manual controlled ascent to safe orbit
 - 3. PGNS controlled ascent to safe orbit
- C. For Contingency Operations, practice with backup modes and procedures

EXERCISE 14 - LM Aborts

- A. Aborts
 - 1. Mission
 - a. Return from translunar flight with DPS and APS (SPS Failure)
 - b. Circumlunar abort with DPS
 - 2. Descent
 - a. PGNS abort to safe orbit
 - b. AGS during coasting descent
 - c. Manual abort to safe altitude
 - d. AGS abort with APS during powered descent (DPS failure)

TABLE 5.6 - EVA, IVA AND STOWAGE TRAINING SUMMARY

MODULE	STOWAGE REVIEWS		ONE "g" WALKTHROUGHS (EVA)		WATER IMMERSION FACILITY		ZERO "g" AIRCRAFT		PARA	ALTITUDE CHAMBER		PARTIAL GRAVITY SIMULATOR		TOTAL HOURS
	EXER.	HRS.	EXER.	HRS.	EXER.	HRS.	EXER.	HRS.		EXER.	HRS.	EXER.	HRS.	
CM	3	12	6	12	3	6	2	6	80	1	4			40
LM	3	12	18	38	5	10	2	6	80	1	4			70
Tunnel	2	6	4	8	6	12	1	3	30					29
EMU			1	2						1	4			6
Lunar Surface			12	37	4	8						5	15	60
Total	8	30	41	97	18	36	5	15	190	3	12	5	15	205

TABLE 5.7 - GEOLOGY COURSE SUMMARY

<u>LECTURE</u>	<u>HOURS</u>
(1) Review	8
(2) Rock Hand Specimen Descriptions	4
(3) Meteorite Hand Specimen Descriptions	2
(4) Shocked Rocks Hand Specimen Descriptions	2
(5) Orbiter, Surveyor and Ranger Photography	4
(6) Orbiter Photography and photogeology of specific Apollo sites (4 hours devoted to prime site and 1 hour on each alternate site).	
	6
TOTAL	<u>26</u>
<u>FIELD TRIP (2 Days Each)</u>	
(1) Review of Hand Specimen Petrology, Interpretation of Field Relationships and Sampling Exercises in Heterogeneous Rock Units (Big Bend Park, Texas).	15
(2) Mission Simulations on Basaltic Lava and Ash Fall Surfaces (Bend, Oregon or Pinacates, Mexico).	15
(3) Mission Simulations on Very Large Ash Flows and Ignimbrites (Nevada, Utah).	15
(4) Mission Simulations on Ejecta Blankets from Explosion Craters in Alluvial Gravel and in Volcanic Rocks. Study of Collapse Craters (Nevada Test Site).	15
(5) Mission Simulations on Craters Caused by Hypervelocity Missile Impacts in Alluvium (White Sands Missile Test Site).	15
	15
TOTAL	<u>75</u>

NOTE: Field Trip hours include one hour presimulation and two hours post simulation briefing/debriefing time.

TABLE 5.8 - CENTRIFUGE TRAINING SUMMARY

(MSC FLIGHT ACCELERATION FACILITY)

	RUN	STATIC- DYNAMIC	TARGET RANGE	FLT. PATH ANGLE	TECHNIQUE	SUIT
DAY 1						
A.M.-Prim CMP	1	Static	1265	-6.49	EMS Ranging	--
P.M.-B/U CMP	2	Dynamic	1238	-5.75	EMS Ranging	--
(shirtsleeve)	3	Dynamic	1277	-6.75	EMS Ranging	--
	4	Dynamic	943	-6.49	Constant 4g	
	5	Dynamic	1296	-7.10	EMS Ranging	
DAY 2						
A.M.-Prime Crew	1	Dynamic	1265	-6.49	EMS Ranging	Vented
P.M.-B/U Crew	2	Dynamic	1246	-6.00	EMS Ranging	Vented
(Suited)	3	Dynamic	1296	-7.10	EMS Ranging	Vented
	4	Dynamic	943	-6.49	Constant 4g	Pressurized

6.0 FIGURES

APOLLO LUNAR LANDING CREW TRAINING SCHEDULE

(Block increments do not indicate duration of activity, only the sequence)

★ Indicates training that may be initiated prior to F-12 months.

MONTH TO LAUNCH

TRAINING ACTIVITY	12	11	10	9	8	7	6	5	4	3	2	1
CSM/LM OCP's, DCS's & TCP's												
SYSTEMS BRIEFINGS CSM AND IM ★												
L/V BRIEFINGS AND REVIEWS												
LUNAR SURFACE BRIEFINGS AND EXERCISES ★												
GEOLOGY TRAINING ★												
LLTV CHECKOUT AND PROFICIENCY ★												
PROCEDURES REVIEWS (C/L, AOH, ABORT)												
FLIGHT PLAN REVIEWS												
PILOT MEETINGS	1st and 3rd Monday each month until crew residence at Cape											
SUPPORT TEAM (TRAINING, TEAM)	As required until launch											
G&N BRIEFING & PROGRAM VERIF. (MIT)												
FLIGHT READINESS REVIEW												
CMS - MSC												
LMS - MSC												
CMS - KSC												
LMS - KSC												
CMPS												
LMPS												
DCPS												
TDS & RDS												
CENTRIFUGE												
CONTRACTOR SIMULATORS												
EMU TRAINING AND CHECKOUT ★												
EGRESS TRAINING												
EVA TRAINING												
STOWAGE REVIEWS												
PLANETARIUM ★												